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Yes/No Question Intonation in Urban Najdi Arabic

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Abstract

Research on intonation in spoken varieties of Arabic has revealed a high degree of variability across dialects. Question intonation in particular may be a locus of variation, since the morphological structure of questions itself varies. This study examines the intonational patterns of Yes/No questions in Urban Najdi Arabic. Although it is a widely spoken dialect, intonation in Urban Najdi Arabic has not yet been formally examined within the autosegmental-metrical (AM) framework. Participants in an experiment completed a picture description task to elicit Yes/No question productions. The results revealed that speakers used two phrase-final intonation patterns to mark Yes/No questions: High-High% and Low-High% boundary tones. Acoustic analyses confirmed the presence of systematic pitch differences in accordance with these two labeled boundary tones. Differences were found in measurements of pitch range and pitch change within the accented syllable, final word of the question, and the final syllable of the question. These findings are compared to recent analyses of other varieties of Arabic and have implications for typological descriptions of Arabic intonation.

Index Terms: Yes/No questions, pitch, intonation, Arabic

1. Introduction

Previous research on spoken varieties of Arabic has shown that there is a significant amount of intonational variation among them [1]. One structure in which intonational differences across a number of Arabic varieties have been found is Yes/No questions (YNQs). Cross-linguistically, it is common for YNQs to have final rising intonation, while statements tend to have falling intonation [2,3], and this is true for most Arabic varieties. In Modern Standard Arabic, YNQs are marked by a final rising contour as well as an obligatory question word (/hal/ "does" at the beginning of the question) [4]. However, in many spoken varieties of Arabic, YNQs do not contain an obligatory question word and have the syntactic structure of declarative sentences. YNQs may then by necessity be distinguished by prosodic means [5]. The current study examines Urban Najdi Arabic (UNA), a variety spoken in Riyadh, Saudi Arabia, to determine whether YNQs are signaled by intonation patterns.

Arabic is generally characterized as a "stress-accent" language, in which certain syllables are more prominent than other syllables in the word [6]. In Arabic, pitch accents are assigned post-lexically and are associated with lexically stressed syllables [7]. Lexical stress is predictable in Arabic and the number and length of syllables determines stress assignment [8]. The rules for stress assignment can be summarized as follows:

Stress falls on the ultimate syllable if it is superheavy (CVCC, CVVC) as in /xa.**li:g**/ "gulf". Otherwise, stress falls on a heavy penultimate (CVV, CVC) as in /bi.**da:**.jah/ "beginning". If the penultimate is not heavy, stress falls on a heavy antepenultimate (CVV, CVC) as in /rat.**tab**.ta.ha/ "I organized it". Finally, stress falls on the penultimate in two syllable words (CV.CV) /**na**.ma/ "it grew" or the antepenult in three or more syllable words (CV.CV.CV) as in /**ka**.ta.bu/ "they wrote" [1,9]. Pitch accents at the phrasal level fall on the stressed syllable in an accented word.

Although many studies have reported a final rising contour for YNQs in Arabic, the specific nature of the final rise differs greatly across dialects. For example, in Lebanese Arabic, the final rise is usually preceded by a low pitch accent (L*) but sometimes a high pitch accent (H*) can occur [7]. In Egyptian Arabic, the preceding pitch accent is always a low to high accent (L+H*) [10]. The final rising contour for YNQs shows a steeper rise than any other type of rising contours in Egyptian Arabic [5]. In Lebanese Arabic, YNQs show an overall rising contour [1]. However, in addition to the differences in the way final rises are realized, some varieties of Arabic, such as Kuwaiti [11] and Bedouin [12] mark YNQs with an initial-rising contour instead; this is particularly true when focused elements are utterance-initial.

Such differences across spoken varieties of Arabic reflect variability in the relationship between specific intonation contours and pragmatic meaning. Identifying and quantifying these differences is necessary for more accurate descriptions of Arabic intonation. Since Urban Najdi Arabic is a dialect in which YNQs do not need to contain an obligatory question word, the current study examines the prosodic structure of these questions. Specifically, we ask (a) whether YNQs are marked by means of rising intonation in UNA, and (b) what is the nature of the intonational patterning in this type of question? This analysis adopts the autosegmental-metrical (AM) framework [13] to examine the intonation of YNQs in UNA.

2. Experiment

2.1. Participants

Eight native speakers of UNA (ages 19-30, 4 males and 4 females), with no reported speech or hearing disorders, were recruited to participate in this study. The participants were students at George Mason University. Participants were asked to take part in a picture description task and were informed that their productions would be audio recorded for further analysis. They received nominal monetary compensation.

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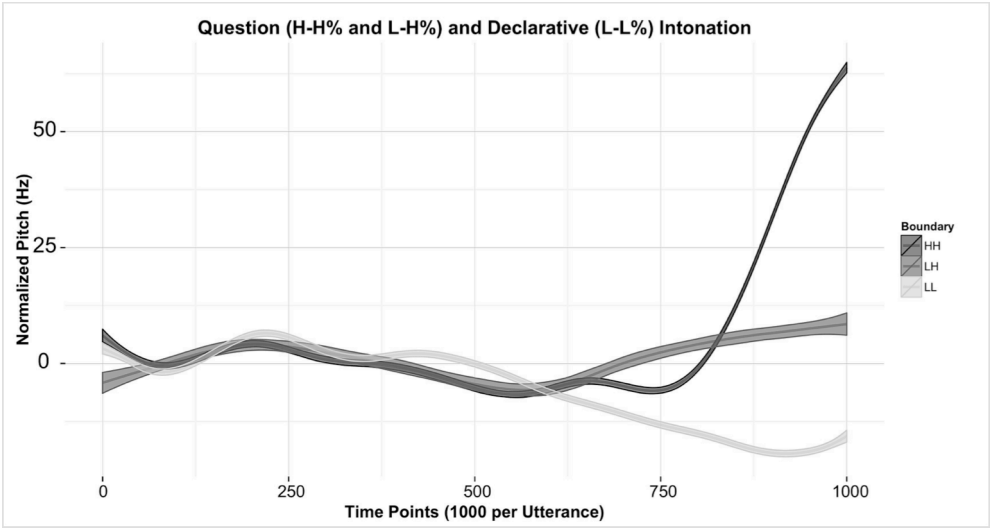

Figure 1: *Modeled F0 contours for Yes/No Questions and declarative sentences. Contours were modeled with the ssanova function in the "gss" package in R [15]. Ribbons represent 95% confidence intervals around pitch contours for Boundary types: H-H%-YNQ, L-H%-YNQ and L-L%-declarative.*

2.2. Stimuli

Twenty five experimental and five training pictures were used to elicit simple YNQs from native UNA speakers. The pictures were all cartoon drawings, depicting one simple event. For example, in one picture there was a boy wearing a red jersey and holding a basketball with one hand; a participant might have asked, "Is the boy playing basketball?". Another twenty five pictures were used to elicit declarative utterances. Here we focus primarily on the data from YNQs and make reference to the declarative utterances for comparison.

2.3. Procedure

Participants were seated in a sound-attenuated booth and were shown each of the 25 pictures. Participants were not told of the specific purpose of the experiment, but were told that in each picture there was an event taking place, and that they should ask a question about that event. To elicit Yes/No Questions, they were told that the experimenter could only answer with a "yes" or a "no". Participants were allowed to ask more than one question about the picture (only 6 extra questions were asked). The interactions between the participants and the experimenter were carried out in UNA by the first author. Recordings were made using a ZOOM, H2n digital audio recorder at a sampling rate of 44.1 kHz.

2.4. Data Analysis

The audio recordings were analyzed using PRAAT [14]. Each target utterance was extracted and saved as a WAV file. This resulted in a total of 206 YNQs included in the analysis. ToBI labeling conventions for Arabic [7] were used to identify vowels in the final word of the questions and to assign pitch accents and edge tones to each YNQ utterance. Measurements were taken for the minimum and maximum pitch (Hertz) in each vowel in the final word of the YNQs. Analyses were then performed on measurements from the accented syllable, the final syllable of the utterance, and the final word of the utterance as a whole. The amount of pitch change within the accented syllable and within the utterance-final syllable were calculated by subtracting the minimum pitch form the maximum pitch within that syllable. The amount of pitch change over the utterance-final word was calculated by subtracting the minimum pitch of the first vowel from the maximum pitch of the final vowel (in all cases of rising intonation). The data were labeled by the first author, a native speaker of Urban Najdi Arabic, using ToBI labeling conventions.

3. Results

Yes-No Question intonation contours showed two configurations at the final edge of the phrase: a rising edge configuration (H-H%) (81.55% of utterances), and a fall-rising (or low-rising) configuration (L-H%) (18.45% of utterances). These labels were assigned according to ToBI conventions, based on the timing and degree of pitch rise. The edge and boundary tones were always preceded by a low pitch accent (L*) associated with the nuclear accented syllable. Both of the YNQ intonation patterns were distinct from those of the declarative sentences produced by the same participants, which always exhibited an L* accent followed by a L-L% boundary tone (Figure 1). The final falling contour (L*L-L%) at the edges of phrases in declarative sentences is consistent with findings from other varieties of Arabic (e.g., MSA, Lebanese, Egyptian). Figure 1 shows modeled pitch contours (normalized by speaker) of the YNQ intonation contours compared to the declarative sentences, and demonstrates the two distinct intonation patterns used in YNQs.

As expected, pitch accents were associated with lexically stressed syllables, most often on a non-final syllable. In order to examine a possible effect of the location of the pitch accent on the phrasal intonation contour, the data were divided into four categories according to the location of the stressed syllable: initial, antepenultimate, penultimate and final. Accent location for monosyllabic words was coded as final in these data. The distribution of pitch accents for each intonation contour are presented in Table 1. The presence of both intonation contours (L-H% and H-H%) for each accent location suggests that the intonation contour was not

determined by accent location. In the following sections, we present the acoustic measurements of pitch (F0 in Hz) in the YNQs.

	L*H-H% (168)	L*L-H% (38)
Initial (86)	72 (42.86%)	14 (36.84%)
Antepenult (7)	5 (2.98%)	2 (5.26%)
Penultimate (59)	49 (29.17%)	10 (26.32%)
Final (54)	42 (25%)	12 (31.58%)

Table 1. *Distribution of pitch accent location (number of tokens and percent of total).*

3.1. Pitch

Questions from both edge configurations showed a rising contour; however, the L-H% slope was less steep than the H-H% slope. The amount of pitch change was predicted by the edge tones – edge tones with the H-H% configuration showed greater pitch change than those with the L-H% configuration. The following pitch measurements demonstrate that the distinction made in the ToBI label assignments between L-H% and H-H% was acoustically realized. Statistical significance of the differences in the contours was confirmed with smoothing spline ANOVA implemented with the gss package in R [15]. Phrase boundary, time point, and an interaction between phrase boundary and time point were included as fixed factors, with F0 as the dependent variable. The F0 contours were then modeled with 95% Bayesian confidence intervals (Figure 1). Areas of the contours (i.e., time ranges) where the confidence intervals (ribbons) do not overlap are considered to be significantly different.

3.1.1. Utterance-final Word

Pitch measurements were taken for the entire utterance-final word in order to examine differences between the rising intonation patterns in the L-H% and H-H% questions. As expected, the analysis showed that all words preceding H-H% boundary tones exhibited larger pitch change over the entire word than words preceding the L-H% boundary (Figure 2), indicating that the most pitch rise occurred in H-H% questions. The mean within-word pitch change for H-H% was 54.53 Hz with a mean maximum of 210.33 Hz and a mean minimum of 155.80 Hz. The mean pitch change for L-H% was 31.97 Hz with a mean maximum of 177.77 Hz and a mean minimum of 145.98 Hz.

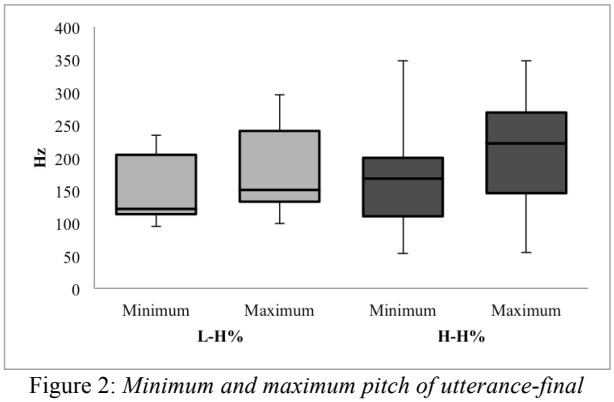

Figure 2: *Minimum and maximum pitch of utterance-final words in L-H% vs. H-H% Yes-No Questions.*

3.1.2. Accented Syllable

As previously mentioned, the pitch accent type for accented syllables was always low (L*). Thus, as would be expected, the amount of pitch change within the accented syllables was not large. The pitch range exhibited an average of 10.08 Hz in accents preceding L-H%, and 14.76 Hz in accents preceding H-H%. The overall pitch range is slightly higher for H-H% than for L-H%. The mean maximum pitch for L-H% was 159.63 Hz and the mean minimum was 149.59 Hz. The mean maximum pitch for H-H% was 173.59 Hz and the mean minimum was 158.82 Hz.

3.1.3. Utterance-final Syllable

Pitch measurements were taken from the utterance-final syllable in order to more closely examine the locus of pitch rise in YNQs. The majority of pitch change occurred on the final vowel of the YNQs. Table 2 shows the percentages of the total amount of pitch change that occurred on the final syllable.

	Accent Location	F0 Change in Word	F0 Change in Syllable	% Change Occurring on Syllable
L-H%	non-final	32.20 Hz	17.08 Hz	53.38%
	final	24.38 Hz	14.49 Hz	59.84%
H-H%	non-final	57.37 Hz	26.94 Hz	46.96%
	final	46.00 Hz	35.45 Hz	77.07%

Table 2. *Percentage of total pitch change occurring on the utterance-final syllable of Yes-No Questions.*

As expected, there was less change within the final syllable of L-H% utterances than H-H% utterances. The mean change in pitch in L-H% words was 16.29 Hz, and in H-H% was 29.06 Hz. The mean maximum pitch for L-H% was 177.43 Hz and the mean minimum was 161.13 Hz. The mean maximum pitch for H-H% was 209.60 Hz and the mean minimum was 180.53 Hz (see Figure 3).

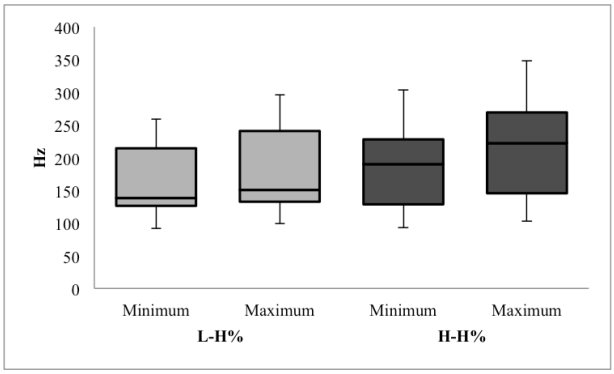

Figure 3: *Minimum and maximum pitch of utterance-final syllable in L-H% vs. H-H% Yes-No Questions.*

4. Discussion

The results of this experiment revealed that YNQs in Urban Najdi Arabic are associated with specific prosodic structures, namely, rising intonation contours. Thus, despite the absence of an overt question word, YNQs are distinguished from declarative sentences in discourse. The finding that the pitch

accent on the final word of the YNQs was always low (L*) is consistent with previous findings for other varieties of Arabic [1,7]. The L* pitch accent in these data could be described as a low and flat pitch contour. This was confirmed by small amounts of pitch on the accented syllable change (< 8 Hz) when it was not in final-syllable position (in which cases it was subject to rising pitch associated with the high boundary tones).

Two edge and boundary tone patterns emerged for YNQs in UNA. The distribution of these two patterns shows that H-H% is more commonly used than L-H%. The use of the H-H% contour has been shown to vary across dialects of Arabic. In Lebanese Arabic the H-H% tone is used in Wh-questions, in addition to YNQs [7]. In Egyptian Arabic, H-H% can also be used to indicate incompleteness (and treated as a continuation rise) [16]. However, Chahal et. al [1] suggest that the difference between the H-H% tones indicating YNQs and those indicating incompleteness lies within the difference in the global pitch patterns of the two utterance types. That is to say, utterances with final continuation rise show an overall falling declination in pitch preceding that rise, whereas in YNQs there is an overall rising pitch throughout the utterance. In the current study, what is observed for H-H% YNQs is parallel to what is reported for Egyptian Arabic. The global pitch pattern for YNQs is rising when compared to declarative sentences. In these data, both the H-H% questions and the L-H% questions appear to follow a similar trajectory until the final rise (Figure 1). In future research, it would be interesting to compare YNQs with utterances elicited in the environment of an expected "continuation rise" in UNA.

In Egyptian Arabic, it has been reported that YNQs that do not have a question word at the beginning of the utterance display an overall rising pattern that is slightly distinguished from YNQs that contain a question word [1,5]. While both types of YNQs show an overall rising pitch pattern, the slope is steeper for YNQs with no question word [5]. In the current study, only one participant produced YNQs with a question word (a total of five tokens). All of these questions ended in a H-H% configuration. However, comparing that speaker's pitch values for YNQs with a question particle to YNQs without a question showed no difference between the two question types – there may be too few tokens in this dataset to draw conclusions on this point.

Interestingly, in the present study, L-H% tones were sometimes used to mark YNQs. The L-H% configuration is typically a continuation rise in many languages including English and some varieties of Arabic [1,2,17]. The L-H% tones could be described for UNA as being a relatively low, flat tonal pattern followed by a rise to the mid-pitch range of the speaker. It has been reported in the literature that L-H% combination is one of three possible continuation rises in Lebanese Arabic, however it has been described as uncommon [1,7]. According to Chahal [7], the falling rising tune (i.e., L-H%) showed an overall rising pattern in Lebanese Arabic. Chahal suggests the possibility that the L-H% combination is borrowed from English. In the current study, the L-H% utterances showed an overall rising pattern similar to Lebanese Arabic. In the current data, we cannot eliminate the possibility that the L-H% pattern is a borrowing from English; all of the participants speak English as a second language and have been living in an English-speaking country. In addition, not all of the participants used the L-H% pattern in their speech. However, in Egyptian Arabic, L-H% intonation is associated with irony or expression of disapproval or disappointment [1]. It could also be an indication of uncertainty. These possibilities are particularly interesting and require further examination of L-H% configuration in UNA. Future research could test listeners' perception of whether L-H% contours can be perceived as YNQs by native speakers of UNA, and if not, how they are perceived.

Analyses on the pitch values for the accented syllables revealed two patterns. 1) The overall pitch values within the accented syllable for words ending in H-H% were higher than in L-H% environments. 2) The amount of pitch change over the accented syllable was slightly greater in words with H-H% configuration than it was in words with L-H% configuration. This is interesting because the pitch accent was always the same (L*) for both intonational configurations. Thus, this pattern could be the result of anticipation of the following tone, since in L* L-H% utterances, the pitch accent L* is followed by a low phrase tone L- and in the L* H-H% utterances, the pitch accent L* is followed by a rising phrase tone H-. These patterns were observed regardless of the number of syllables within the utterance-final word.

The pattern observed for accented syllables also holds true for the overall pitch pattern for the final words in the questions. Utterance-final words in questions with H-H% intonation showed an overall pitch range that is higher than the pitch range in words with L-H% intonation. The amount of pitch change was also greater, with a steeper rise for final words in H-H% than L-H% utterances. Most of the pitch change occurred on the utterance-final syllable regardless of the accent location. Further, the amount of pitch change on the utterance-final syllables with H-H% and L-H% intonations was greater when the accent was on that final syllable.

5. Conclusion

The results of this study revealed that YNQs in UNA can be distinguished from declarative sentences by means of intonation. Two boundary tones occurred in the YNQs, namely L-H% and H-H%. H-H% is most likely the typical or "default" YNQ configuration for UNA and other varieties of Arabic. L-H% was the less likely boundary tone combination in YNQs in UNA. This pattern has not been observed for YNQs in other varieties of Arabic. Pitch measurements confirmed that there were acoustic differences between these two boundary tone combinations. H-H% showed a steep rising contour and a higher pitch range. L-H% showed a less steep rising contour with a lower overall pitch range. These differences suggest clear distinctions made by the speakers in the production of YNQs.

Despite the broad similarities between UNA and other varieties of Arabic, it is clear that these varieties have unique intonational features that need to be taken into consideration in descriptions and models of Arabic intonation. Further investigation of different utterance types and dialects will also contribute to this goal.

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7. References

[1] D. Chahal and S. Hellmuth, "The intonation of Lebanese and Egyptian Arabic," In Jun S.-A. (eds.) *Prosodic Typology II: The Phonology of Intonation and Phrasing*, pp. 365-404, OUP: Oxford, 2014.

[2] D. R. Ladd, *The structure of intonational meaning: evidence from English*, Bloomington: Indiana University Press, 1981.

[3] D. R. Ladd, *Intonational Phonology*, Cambridge: Cambridge University Press, 1996.

[4] J. Ouhalla, and U. Shlosky, (eds.) *Themes in Arabic and Hebrew Syntax*, New York: Springer, 2002.

[5] O. Ibrahim, S. H. El-Ramly and N. S. Abdel-Kader "A model of F0 contour for Arabic affirmative and interrogative sentences" in *the proceedings of the 18th National Radio Science Conference*, pp. 517-524, Mansoura University, Egypt, 2001.

[6] J. McCarthy, "On stress and syllabification," *Linguistics Inquiry*, vol. 10, pp. 443-466, 1979.

[7] D. Chahal, *Modeling the Intonation of Lebanese Arabic using Autosegmental-Metrical Framework: a Comparison with English*, Ph.D. dissertation, University of Melbourne, 2001.

[8] J. McCarthy, "Sympathy, cumulativity, and the Duke-of-York gambit," In C. Féry and R. van de Vijver (eds.), *The syllable in Optimality Theory*, pp. 23–76, Cambridge: Cambridge University Press, 2003.

[9] J. Watson, "Word stress in Arabic," In M. Marc van, C. J. Ewen and E. V. Hume (eds.) *The Blackwell Companion to Phonology*, vol. 5, pp. 2990–3018, 2011.

[10] S. Hellmuth, *Intonational Pitch Accent distribution in Egyptian Arabic*. PhD dissertation, SOAS, University of London, 2006.

[11] L. Alharbi, *Formal analysis of intonation: the case of the Kuwaiti dialect of Arabic*, PhD dissertation, Heriott-Watt University, 1991.

[12] J. Rosenhouse, "Features of intonation in Bedouin Arabic narratives of the Galilee (North Israel)," In T. Harviainen and A. Parpola (eds.), *Dialectologia Arabica: A Collection of Articles in Honor of the sixtieth Birthday of Professor H. Palva, Studia Orientalia*, pp. 193-215. Helsinky: Finnish Oriental society, 1995.

[13] M. Beckman and J. Hirschberg, *The ToBI annotation conventions*, Manuscript, Ohio State University, 1994.

[14] P. Boersma and D. Weenink, *Praat: doing phonetics by computer*, (Version 5.4.22) http://www.praat.org/, 2015.

[15] R Core Team, *R: A language and environment for statistical computing. R*, Foundation for Statistical Computing: Vienna, Austria. ISBN 3-900051-07-0, URL http://www.R-project.org/, 2013.

[16] K. Rifaat, "The structure of Arabic intonation: a preliminary investigation," In M.T. Alhawary and E. Benmamoun (eds.), *Perspectives on Arabic Linguistics XVII-XVIII: Papers from the seventeenth and eighteenth annual symposia on Arabic linguistics*, pp. 49–67, Amsterdam/Philadelphia: John Benjamins, 2005.

[17] J. Pierrehumbert "Synthesizing intonation," in *Journal of the Acoustical Society of America*, vol. 70, no. 4, pp. 985-995, 1981.